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THE CARAPACE AND PLASTRON  
OF *BASILEMYS SINUOSUS*,  
A NEW FOSSIL TORTOISE FROM THE  
LARAMIE BEDS OF MONTANA.

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THE CARAPACE AND PLASTRON OF *BASILEMYS SINUOSUS*,  
A NEW FOSSIL TORTOISE FROM THE LARAMIE  
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BY E. S. RIGGS.

An unusually well-preserved shell of a tortoise (P. 12008) collected by the Museum Expedition of 1904 presents new and interesting characters. The specimen is evidently closely related to a form described\* by Cope from the Judith River Beds of Montana as *Compsemys variolosus*. This, with a more complete specimen from the Belly River series of Alberta, was later referred† by Lambe to the genus *Adocus*, and finally by Hay to a proposed new genus, *Basilemys*‡. The size of the specimen under consideration is almost identical with that described by Lambe and the dermal markings are very similar, but it differs notably in the form of the anterior end of the plastron and the arrangement of gular shields. The median sulcus of the plastron is remarkably sinuous, crossing and recrossing the median line and often deviating widely from it. On account of this character the specific name *sinuosus* is proposed for it. It is provisionally referred to *Basilemys* pending the definition of that genus.

The specific characters are as follows: Anterior end of plastron produced into a thick rounded knob; gular shields long and narrow and meet at the median line; median sulcus unusually sinuous.

The specimen as a whole is in a fine state of preservation. It was found in a bed of hard but uncemented sand containing bones of *Triceratops*, *Trachodon*, and other characteristic Laramie fossils. The shell was lying on the plastron in its normal position. It has been somewhat flattened by compressure in the vertical direction. The carapace is complete with the exception of a few fragments missing from the vertebral region and a section from the right side, including the posterior half of the second and the anterior half of the third pleural plates, together with the greater part of the fifth and the anterior part of the sixth peripheral plates. Much of the contact between the carapace and plastron is also lost. The remainder of the plastron is preserved entire. However, the inferior surface is modified by compressure so as to be deeply concave.

\*Pro. Acad. Nat. Sci. Phila. 1876, p. 257.

†The Ottawa Naturalist, Vol. XVI. p. 63.

‡Nomen Nudum, Bull. U. S. Geol. Surv. Nov. 179, p. 445.

The shell is in general structure broad and low, flat and emarginate at the interior end, but steep posteriorly. The carapace and plastron are firmly united by a wide bridge which extends more than half the entire length of the shell. The whole of the free surface is marked by pittings which vary in depth, structure, and arrangement in different parts of the shell. The horny shields are outlined by narrow sulci which are plainly marked in the vertebro-costal region, and in the plastron, though less conspicuous between the marginals. The sutures joining the bony plates are everywhere closed, so that in some places they cannot be traced by the aid of a lens. The centra of the dorsal vertebræ have been detached and lost from the specimen entirely. The neural plates bear on their inferior surfaces an interrupted median ridge indicating the attachment of the neural spines. The proximal ends of the pleural plates bear stout tubercular processes for vertebral attachment. Plate LXXVII.

The *carapace* is relatively thin throughout. The anterior end is unusually flat, a character which has evidently been accentuated by compressure in fossilization. The nuchal border is rounded and indented by a wide concavity. Elsewhere the free margin is drawn to a sharp angle. The posterior end is markedly convex in the pygal region. The margin is slightly recurved over the femora, but uniformly convex and overhanging at the median line. Plate LXXVII.

The *neural plates* are irregularly hexagonal, but vary in size and in outline. A certain amount of asymmetry is also noticeable in them. The first is broadly coffin-shaped, with the large end directed backward. It articulates laterally with the first pair of pleurals, postero-laterally with the second pair, and posteriorly by a concave line with the second pleural. The second is sub-ovate in outline and notably smaller than the first. Its pleural articulation is confined to the second pair. The third neural is a trifle smaller than the first and has an outline similar but reversed in position. Thus it articulates antero-laterally with the second pair of pleurals and laterally with the third pair. The entire fourth and part of the fifth are missing from this specimen. They were evidently narrower than the third but similar in form. The sixth is notably asymmetrical. The anterior end and right side have the usual form, but the left side is elongate so as to articulate with the whole mesial end of pleural VI and postero-laterally by a short line with pleural VII. The seventh neural is thus excluded from its normal articulation on the left with pleural VII, and is correspondingly asymmetrical. It is also much smaller. The eighth neural is much shortened antero-



posteriorly and lies opposite the suture between pleurals VII and VIII. A ninth irregularly rounded plate intercolated between the last pair of costals may be regarded as a post-neural.

The *pleural plates* extend only about two-thirds of the distance from the neural suture to the margin of the carapace. Their articulation with the neurals has been described in the preceding paragraph. Distally they articulate with the marginals, breaking joints in a mosaic pattern. Pleurals I to III inclusive are directed obliquely forward. Pleural IV stands at a right angle to the median line. From this point the remainder of the series becomes more and more directed obliquely backward until the last pair conforms to the wide A-shape of the first pygal. Pleural I is much the broadest of the series, articulating anteriorly with the nuchal and peripherals one and two. Distally it abuts the whole mesial border of peripheral three and a small anterior portion of four. Pleural II is long and narrow, meeting only two-thirds of peripheral four. Pleural III is widest at the distal end, articulating antero-laterally with the fourth and laterally with the fifth peripheral. Pleural IV is uniform in width, and has a distal articulation similar to the preceding. Pleural V is slightly expanded toward the extremity and presents an almost equal surface to marginals six and seven. The suture between Pleurals V and VI is unusually sinuous. The latter element is noticeably narrower and has its distal articulation similar to the preceding. Pleural VII is shorter, and much narrower at the mesial end. It articulates distally with peripheral eight by a short suture, but chiefly with nine. Pleural VIII is shortest and smallest of the series. It arises from the eighth and ninth neurals, and is more uniform in width than the preceding. It meets peripheral nine in a short antero-lateral suture as well as half the mesial surface of peripheral ten.

The first *pygal plate* has the form of a wide A. Its lateral wings are co-extensive with the last pair of pleurals, with which they articulate anteriorly. Laterally they abut a third of the mesial surface of peripheral ten. The posterior surface is concave to receive the rounded surface of the succeeding element. The second pygal is a wide irregular figure, convex on the anterior surface and bounded by three concave facets posteriorly. These facets articulate with the eleventh pair of peripherals and the third pygal. Laterally this bone also presents a small pair of surfaces to the postero-lateral faces of the tenth pair of peripherals. The third pygal is not more than half as large as the second and is sub-hexagonal in outline.

The *peripherals* are eleven in number exclusive of the nuchals and last pygal. The series as a whole is unusually deep, especially in the lateral region where the plates above the angle of the carapace are more than half the length of the adjacent pleurals. Only the last pair is covered entirely by the marginal shields. The nuchal differs from the common hexagonal type in that the anterior border forms a reëntrant angle at the median line. The peripheral bones gradually increase in depth from first to fourth. The fourth, fifth, and sixth are similar in size and are largest of the series. With the seventh there is a decided reduction in antero-posterior diameter. The ninth and tenth diminish rapidly in length, the eleventh is much the smallest of the series. The tenth presents an equal surface to articulate with the eighth pleural and the first two pygals. Peripherals three to seven inclusive form the bridge.

The *vertebral shields* are notably variable in outline. The first has the form of an irregular truncated pyramid with its base at the anterior marginal suture. In this specimen it is quite asymmetrical. The second, third and fourth are much longer than wide. The second and third are sub-rectangular in outline and nearly equal in size. The fourth is somewhat smaller, narrower at the posterior end and more irregular in outline. The fifth is the largest of the series. It has the form of a wide triangle whose base is at the posterior marginal suture.

The *costal shields* are four in number. The first has the form of a quadrant of a circle whose center is at the mid-lateral border of vertebral II. It overlies the greater part of the first and half of the second pleural, as well as parts of the first four peripheral bones. The second and third costals are rectangular in outline. The second is somewhat broadest in its antero-posterior diameter and extends over the posterior half of the second, all of the third and the anterior half of the fourth pleural plates, as well as parts of the fourth, fifth and sixth peripherals. The third costal shield bears a similar relation to the fourth, fifth and sixth pleurals, and the sixth, seventh and eighth peripherals. The fourth costal shield is an irregular quadrilateral and is the smallest of the series. Its relation to the neural and peripheral plates is similar to that of the second and third. The intercostal sulci have the usual position opposite the middle of the vertebral shields.

The *marginal shields* are twenty-five in all. The sulcus separating them from the vertebrae and costals falls far without the pleuro-peripheral suture and is little more plainly marked than those in the

vertebral region. The nuchal shield is very small. It is narrow in its superior aspect but rapidly widens as it rounds the anterior margin. The first pair of marginals are long and narrow; the second and third increase regularly in breadth. The fourth to seventh, inclusive, overlie the bridge. Their distal articulation will be described with the plastron. The eighth, ninth and tenth diminish slightly in depth in the order named. The eleventh increases rapidly in depth toward the mesial border. The pygal is deepest of the series and is paired.

The *plastron* is suggestive of great rigidity and strength as indicated by the wide bridges with thickened buttresses and firmly interlocking sutures, the massive anterior process formed by the *epiplastra*, and the thickened and rugose borders. The pittings are more deeply marked than on the carapace, and the arrangement of shields is unusually complicated. In its entire length the median sulcus crosses the median suture fourteen times. At no point does it coincide with the median suture. Compared with the plastron of *B. variolosus* as figured by Lambe\* there is a great similarity. However, the *epiplastrals* in this form are more produced, the *entoplastron* noticeably larger, the gular shields meet at the median line, and the median sulcus is much more sinuous. Plate LXXVIII.

The *epiplastra* unite at the median suture to form a thick and rounded knob, which may be termed the gular eminence. The distal ends appear on the inferior surface as a pair of wing-like processes which are directed postero-laterally. The *entoplastron* is sub-hexagonal in outline and one-third broader than long. Its anterior margin joins the *epiplastra* in two approximately straight lines which meet in an angle of sixty degrees. The lateral borders are short, the posterior angle very obtuse. The *hypoplastra* are somewhat larger than the *hyoplastra*. In this specimen there is a break in their connecting suture at the median line. The former articulate laterally with peripherals three, four and five, and postero-laterally they present a short articulating surface to peripherals six. The *hyoplastra* articulate laterally with peripherals six and seven. The *xiphiplastra* extend forward almost to the femoral notches. On the superior surface the gular eminence terminates in a single short median ridge, and is flanked by a pair of marginal ridges which extend half way to the humeral notches. The *entoplastron* bears on a pair of low converging ridges the facets for articulation with the *precoracoids*. The *xiphiplastra* bear a similar but larger pair of facets for ligamentary

\*Geol. Surv., Canada. Vol. III. part II, page 39.



union with the pubic process. From the femoral notch to the median line the margin is elevated to form a sharp ridge, deeply pitted on the free surface.

The *dermal shields* of the plastron are very complex in arrangement. The intergulars are similar on the inferior surface to those of *B. variolosus*, but superiorly they are extended to cover the protruding gular process. Between them the median sulcus twice crosses the median suture. The gulars are long and narrow, and meet at the median line. The humerals are relatively smaller than in *B. variolosus*. They present for union at the median line a surface barely a half-inch in length. The pectoral shields as a pair are similar in outline to those of the species cited, though they extend somewhat farther backward mesially. Between them the median sulcus departs from the median line in a series of meanderings in which it crosses the median suture five times. In the abdominals it follows almost parallel with the suture making a single digression near the posterior border. The abdominals send backward a pair of peculiar narrow processes between the inguinals and femorals to the border of the femoral notch. The femorals are sub-quadrangular in outline, extending laterally to the border of the femoral notch. In the anals the median sulcus presents the most fantastic tracery, crossing the median suture in a series of wide loops, departing from it, in one instance, nearly two inches and finally returning to it at the posterior margin. On account of portions missing at the lateral angle of the carapace it cannot positively be determined whether the marginals are divided into an inframarginal series. From the fact that no evidence of a dividing sulcus can be made out on either side, as well as the opposite position of the vertical sulci on each side of the gap, it is assumed that the series is not divided into marginals and inframarginals, respectively.

From the narrow lateral extremities of the pectorals radiate three wedge-shaped shields. The anterior and smallest is the axillary shield which overlies the axial buttress and extends upward along the free margin of the carapace to join the second nuchal. The other shields radiating from this point are the fourth and fifth marginals. The sixth marginal is very broad at its ventral border, joining nearly the whole lateral surface of the abdominal shield. Two pairs of shields converge at the postero-lateral angle of the abdominals. The most anterior is the seventh marginal, which narrows mesially almost to a point. Back of this lies

\*Proc. Acad. Nat. Sci. Phila. 1876, p. 257.

the inguinal shield which overlies the posterior or inguinal buttress.

The sculpturing of the shell in members of this genus has been variously described. In his original description\* of the type species *B. variolosus* Cope described the dermal markings as follows: "The sculpture consists of round fossae, which are deeply impressed, and are arranged quincuncially, so that their borders never form straight lines. The latter are also more or less angulate on the edges, so that the surface has a more than usually rugose character." Of the species *B. (Compsemys) imbricarius* he writes as follows:\* "The character of this sculpture distinguishes the species and, in the present instance, in a special manner. It consists in the *C. imbricarius* of excavations bounded on the sides by a short ridge each, which alternate with each other. Thus each bounding ridge terminates abruptly at the fundus of one of the fossae, while the other end of the fossa rises and contracts to another ridge." In the more complete specimen described by Lambe as belonging to *Adocus variolosus* the markings are described as follows:† "The sculpture consists, when most rugose, of well-excavated pits of rounded hexagonal outline arranged quincuncially; the dividing ridges are angular and narrower than the pits are wide, their angularity and height being more pronounced at the junction of every three pits with each other."

It will be noted that the quotations from Cope's description of *B. imbricarius* and Lambe's characterization of the sculpture in *B. variolosus* describe very similar markings. Moreover, the various types of markings indicated by these three descriptions are all to be found in various parts of the specimen under consideration. In fact, the sculpture in various regions of carapace and plastron varies so widely that no area could be taken as typical with the assurance that fragments from other parts of the shell could be recognized from it.

The pittings are most conspicuous and most regular on the plastron and about the margin of the carapace. In the vertebral region they are least conspicuous and without any regular arrangement. On the superior surface of the gular process and the anterior half of the femoral shields there is to be found the type of sculpture described in *B. imbricarius* in which a sharp ridge terminates abruptly at the fundus of the succeeding pit. It is noticeable, however, that in those portions of the femoral shields which overlie the xiphiplastra the arrangement suddenly changes to a series of irregular diagonal rows.

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\*Ibid.

†Geol. Surv. Canada. Vol. III, part p. 40.

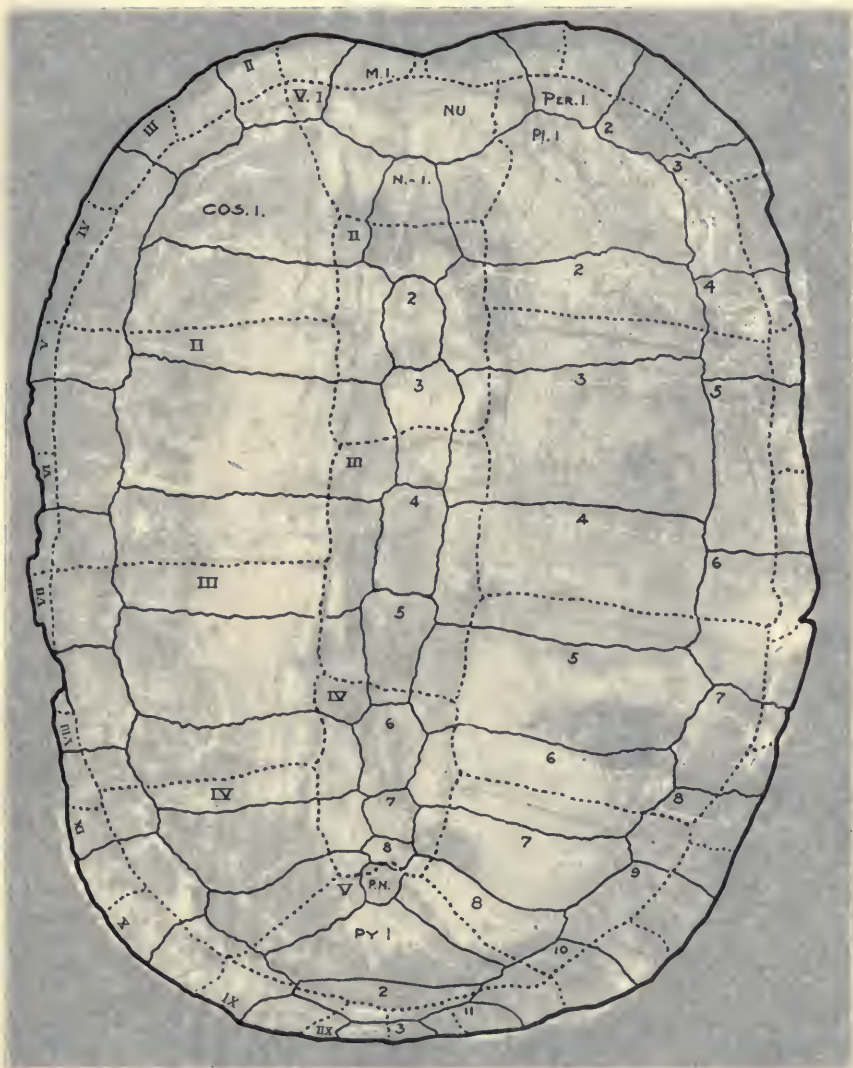


Similarly on the lateral surface of the gular process the markings fall into straight rows in which the pits of adjacent rows alternate so as to form diagonal lines. Thus the pits are in regular rosettes — patterns of six around one. In other parts of the plastron may be occasionally recognized groups of fives, of fours and of threes, but for the most part no regular arrangement is to be recognized.

It is, therefore, probable that if the whole carapace and plastron of *B. variolosus* and *B. imbricatus* were known the same regional variation would be found to obtain. At all events, little reliance can be placed upon the depth or arrangement of pittings as bases for specific determination in this genus.

### MEASUREMENTS.

	M
Length of carapace at median line . . . . .	.705
Breadth of carapace . . . . .	.565
Length of plastron . . . . .	.650
Breadth of hypoplastra . . . . .	.480
Length of bridge . . . . .	.360
Greatest breadth of nuchal plate . . . . .	.145
Least breadth of nuchal shield . . . . .	.007
Greatest breadth of first pleural plate . . . . .	.112
Greatest length of third pleural plate . . . . .	.205
Greatest breadth of anterior pygal . . . . .	.170
Breadth of entoplastron . . . . .	.148
Thickness of epiplastra at gular eminence . . . . .	.060



BASILEMYS SINUOSUS,  $\times \frac{3}{11}$ .

Nu., nuchal plate.

N. 1 to 8, neural plates.

P. N., post-neural plate.

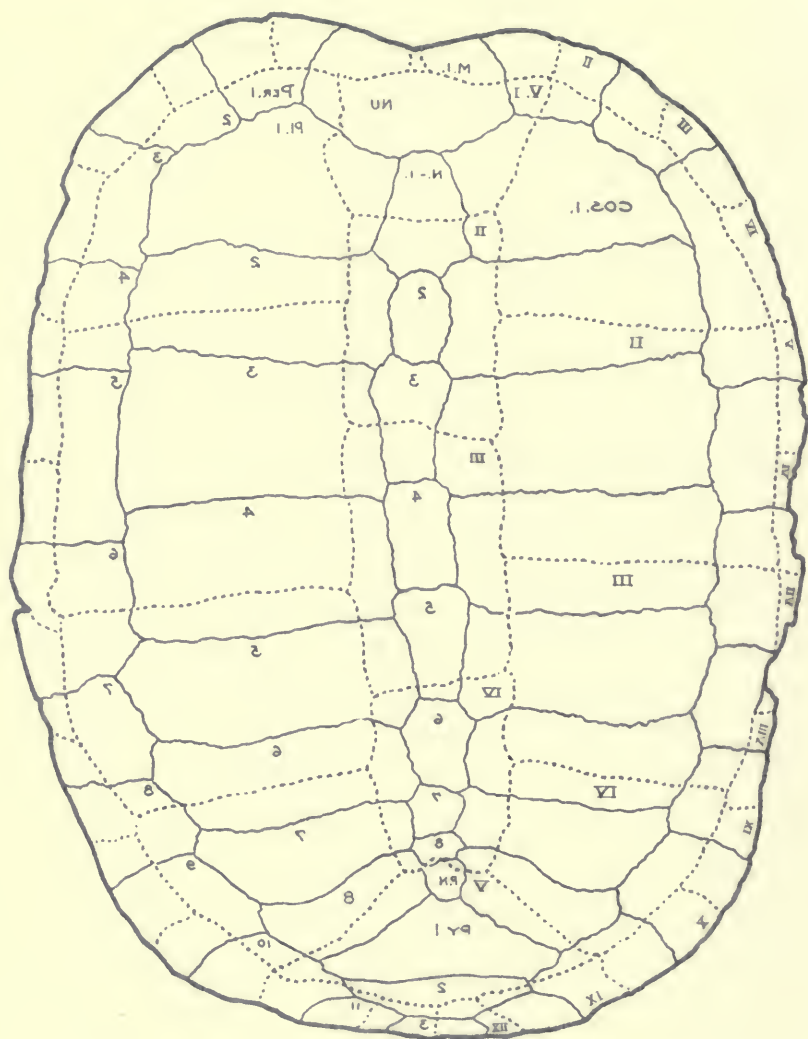
Per. 1 to 11, peripheral plates.

Py. 1 to 3, pygal plates.

V. 1 to V, vertebral shields.

Cos. 1 to IV, costal shields.

M. 1 to XII, marginal shields.



basilemys sinuosa, × 311.

Per. I to XII, marginal shields.  
Cos. I to IV, costal shields.  
V. I to V, vertebral shields.  
Py. I to 3, pygal plates.

Per. I to II, peripheral plates.  
P. N., post-neural plate.  
N. I to 8, neural plates.  
Nu., nuchal plate.



Carapace of *Basilemys sinuosus*, dorsal view,  $\times \frac{2}{11}$ .





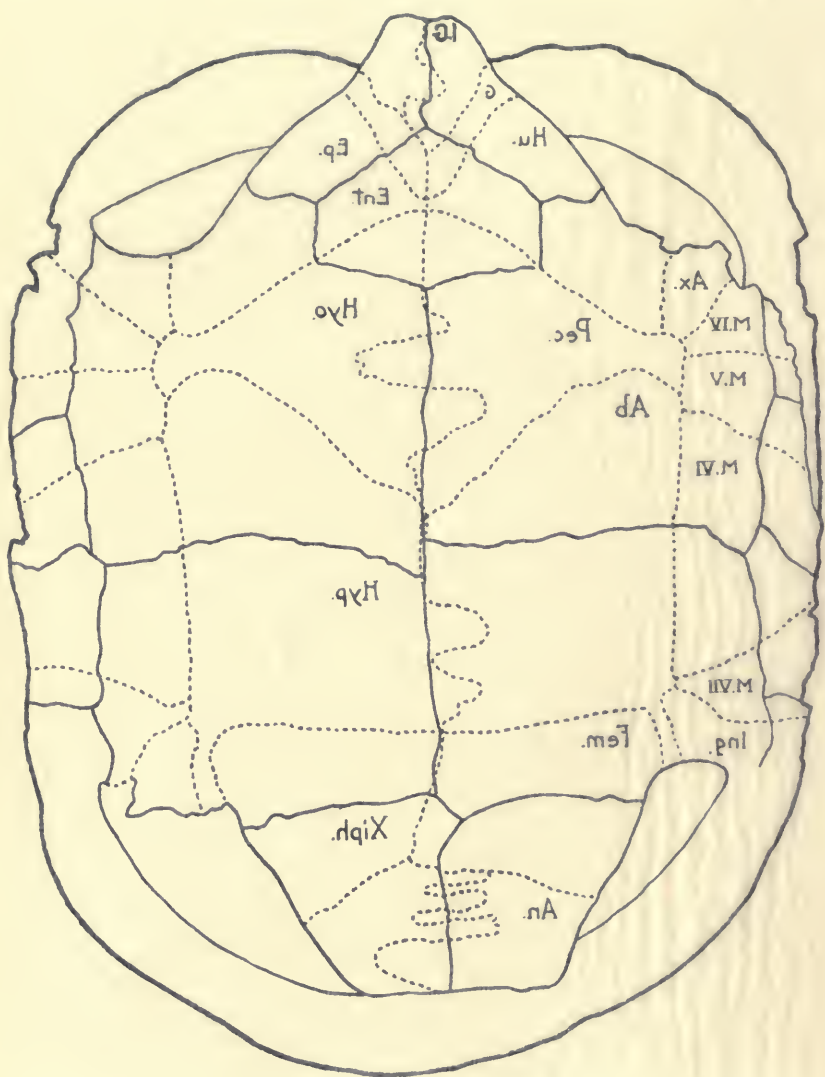


SHIELD OF *BASILEMYS SINUOSUS*,  $\times \frac{2}{11}$ ,  $\times \frac{1}{11}$ .

Ep., epiplastron.  
Ent., entoplastron.  
Hyo., Hyoplastron.  
Hyp., Hypoplastron.  
Xiph., xiphoplastron.  
I. G., intergular shield.  
G., gular shield.

H., humeral shield.  
Pec., pectoral shield.  
Ab., abdominal shield.  
Fem., femoral shield.  
An., anal shield.  
Ax., axial shield.  
M. IV to VII, marginal shield.

Ing., inguinal shield.



BASILEMYAS SINUSUS, x 211.

G., gular shield.  
 I.G., intergular shield.  
 L.G., lateral shield.  
 H., humeral shield.  
 Eut., entoplastron.  
 Hyp., hypoplastron.  
 Xiph., xiphiplastron.  
 An., anal shield.  
 Fem., femoral shield.  
 Ap., apical shield.  
 Pec., pectoral shield.  
 H., humeral shield.  
 Iug., inguinal shield.



Shell of *Basilemys sinuosus*, ventral view,  $\times \frac{7}{11}$ .







Plastron of *Basilemys sinuosus*, visceral surface,  $\times \frac{2}{11}$ .

















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